

What is claimed is:

1. A wavelength division multiplex transmission system, comprising an optical transmission device, a WDM transmission network and an optical receiving device; in which said optical transmission device distributes the transmission signals to be transmitted among a plurality of wavelength components, converts said signals into WDM signals and sends said signals to the WDM transmission network, and said optical receiving device restores WDM signals from the WDM transmission network into said transmission signals; and which has a wavelength component-specific route setting device to set routes for transmission on said WDM transmission network for each of said wavelength components.

2. A wavelength division multiplex transmission system according to claim 1, wherein

said optical transmission device has a plurality of optical channel units, for each of said wavelength components, which convert distributed transmission signals into optical signals at a prescribed wavelength, and signal distribution means which divides transmission signals into a plurality of signals and distributes said signals among said optical channel units; and,

said optical channel units for each wavelength component output optical signals which include labeling information for designating a route set for the own optical channel unit.

3. A wavelength division multiplex transmission system according to claim 1, wherein said optical receiving device

has a plurality of optical receiving units for each of said wavelength components, which convert optical signals at the wavelength component into distributed transmission signals which are electrical signals, and a delay compensation unit  
5 which absorbs differences in the propagation delay of distributed transmission signals from each of said optical receiving units.

4. A wavelength division multiplex transmission system according to claim 1, wherein said wavelength component-specific route setting device has route-setting means which sets routes for each of said wavelength components for transmission through said WDM transmission network, according to route-specific transmission characteristics.

5. A wavelength division multiplex transmission system according to claim 4, wherein

said optical transmission device and said optical receiving device comprise constituent components of transmission characteristic evaluation means for sending, receiving, and evaluating evaluation signals to evaluate  
20 transmission characteristics of prescribed wavelength components for each route, and

said wavelength component-specific route setting device has route-setting means which sets routes for each of said wavelength components for transmission on said WDM  
25 transmission network, according to the evaluation results of said transmission characteristic evaluation means.

6. A wavelength division multiplex transmission system

according to claim 5, wherein said wavelength component-specific route setting device has route-setting means which causes said transmission characteristic evaluation means to evaluate one or a plurality of empty routes for each wavelength component, and sets routes.

7. A wavelength division multiplex transmission system according to claim 5, wherein said signal distribution means has data quantity determination means which determines data quantities for distribution to each wavelength component, according to evaluation results for set routes by said transmission characteristic evaluation means.

8. A wavelength division multiplex transmission system according to claim 4, having transmission quality management means which, during transmission of the WDM signals of said transmission signals, evaluate transmission quality for each wavelength component and control transmission speed for each wavelength component.

9. A wavelength division multiplex transmission system according to claim 8, wherein the wavelength components which are the objects for evaluation of said transmission quality management means are wavelength components with an empty band capacity equal to or less than a prescribed value.

10. A wavelength division multiplex transmission system according to claim 5, wherein, during transmission of the WDM signals of said transmission signals, said signal distribution means comprises data quantity control means which controls the data quantities distributed to each wavelength component

according to evaluation results for set routes by said transmission characteristic evaluation means.

11. A wavelength division multiplex transmission system according to claim 2, wherein, upon occurrence of a defect in any of members of said optical channel units or said optical receiving cards, said signal distribution means redistributes to other optical channel units the data quantity of the transmission signal distributed to the wavelength component of the defective member, according to empty band capacity for each wavelength component.

12. A wavelength division multiplex transmission system according to claim 2, wherein said optical transmission device has an auxiliary optical channel unit which, upon the occurrence of a defect in any of members of said optical channel units or said optical receiving units, functions in place of said optical channel unit to take charge of the wavelength component of the defective member, and said optical receiving device has an auxiliary optical receiving unit which functions in place of said optical receiving unit to take charge of the wavelength component of said defective member.

13. A wavelength division multiplex transmission system according to claim 12, wherein said auxiliary optical channel unit and said auxiliary optical receiving unit process a fixed wavelength component for auxiliary use.

14. A wavelength division multiplex transmission system according to claim 12, wherein said auxiliary optical channel unit and said auxiliary optical receiving unit can change the

wavelength which can be processed, and can be set to and operate at the wavelength component of said defective member.

15. A wavelength division multiplex transmission system according to claim 1, wherein, upon the occurrence of a defect  
5 in a network element in said WDM transmission network, said wavelength component-specific route setting device resets the routes for transmission in said WDM transmission network for all of said wavelength components on routes which have said network element as an element.

16. A wavelength division multiplex transmission system, comprising:

a WDM transmission network having a plurality of routes for transmitting optical signals;

an optical transmission device which converts into  
15 wavelength division multiplex signals (WDM signals) the transmission signals input as electrical signals from a transmission terminal and sends said signals to said WDM transmission network;

an optical receiving device which converts said WDM  
20 signals received from said WDM transmission network into electrical signals, and regenerates said transmission signals for output to an output terminal; and

a network management device which is coupled to said optical transmission device, WDM transmission network and  
25 optical receiving device, and which manages functions for each of these devices; wherein

said optical transmission device and optical receiving

device are designed to cooperate in generating transmission quality information for routes within said WDM transmission network, with said transmission quality information provided to said network management device from said optical receiving  
5 device;

said network management device is designed to apply to said optical transmission device distribution instructions for distribution of each wavelength, to appropriate routes, of said WDM signals; and,

said optical transmission device is designed to distribute said transmission signals, in order to set routes by wavelength for said WDM signals according to distribution instructions, and output distributed transmission signals.

17. A wavelength division multiplex transmission system according to claim 16, in which said optical transmission device comprises:

a distributor to distribute said transmission signals,  
and

an optical channel unit, coupled with said distributor,  
20 to convert into WDM signals each of said distributed transmission signals.

18. A wavelength division multiplex transmission system according to claim 17, in which said optical channel unit comprises an evaluation signal output unit to output, to said  
25 route, evaluation signals used to generate said transmission quality information.

19. A wavelength division multiplex transmission system

according to claim 17, in which said optical channel unit comprises a WDM signal output unit which outputs WDM signals corresponding to distributed transmission signals in accordance with said distributed transmission signals.

5        20. A wavelength division multiplex transmission system according to claim 17, in which said optical channel unit comprises:

10            a WDM signal output unit which outputs WDM signals corresponding to distributed transmission signals in accordance with said distributed transmission signals;

15            an evaluation signal output unit which outputs, to said routes, evaluation signals used in generating said transmission quality information; and,

20            a signal selection unit which controls switching operation between said WDM signal output unit and said evaluation signal output unit.

25        21. A wavelength division multiplex transmission system according to claim 18, in which said optical channel unit is designed such that labeling information for sending on respective corresponding routes of WDM signals and evaluation signals is added to said WDM signals and said evaluation signals according to said distribution instructions, and said signals are output.

30        22. A wavelength division multiplex transmission system according to claim 16, in which said optical receiving device comprises:

          an optical receiving unit which, when said WDM signals

are input from said WDM transmission network, converts said WDM signals into electrical signals at each wavelength and outputs the electrical signals; and

5 a delay compensation unit which compensates for delays, differing by route, of electrical signals at each wavelength.

23. A wavelength division multiplex transmission system according to claim 18, in which said optical receiving device comprises:

an optical receiving unit which, when said WDM signals and said evaluation signals are input from said WDM transmission network, converts said WDM signals and evaluation signals into respective electrical signals at each wavelength, identifies these electrical signals obtained by conversion as WDM signals or evaluation signals, and outputs said WDM signals and evaluation signals; and,

a delay compensation unit which compensates for delays, differing by route, of electrical signals at each wavelength.

20 24. A wavelength division multiplex transmission system according to claim 20, in which said network management device instructs said optical transmission device, WDM transmission network and optical receiving device to acquire empty route information for each wavelength and transmission quality information for empty routes, in response to a communication initiation notification from said optical transmission device,

25 and which comprises optimal route selection means to determine the optimal route from these information, and transmission efficiency optimization means to determine the content of



instructions for distribution of said WDM signals based on these information.

25. A wavelength division multiplex transmission system according to claim 24, in which said transmission efficiency optimization means is designed to send, to said optical transmission device, WDM transmission network and optical receiving device, instructions to switch said WDM signal distributed transmission to said optimal routes according to said acquired information, together with said distribution instruction.

26. A wavelength division multiplex transmission system according to claim 24, in which said transmission efficiency optimization means comprises:

a band-transmission efficiency evaluation unit which applies, to said optical transmission device, WDM transmission network and optical receiving device, instructions to evaluate band capacity usage and transmission efficiency for all wavelengths during transmission of said distributed transmission signals, and which obtains transmission quality information from evaluation signals captured from said optical receiving device; and

a signal distribution determination unit which re-determines the details of distribution of said WDM signals, based on said transmission quality information.

27. A wavelength division multiplex transmission system according to claim 26, in which said transmission efficiency optimization means comprises:

route transmission quality adjustment means which makes a pass/fail judgment on transmission quality, based on said transmission quality information, and which controls the transmission speed of the WDM signal output unit of said optical channel unit, based on the judgment result.

28. A wavelength division multiplex transmission system according to claim 26, in which said transmission quality information comprises defect information which indicates that a defect has occurred in said optical channel unit or said optical receiving unit.

29. A wavelength division multiplex transmission system according to claim 26, in which said transmission quality information comprises defect information which indicates that a defect has occurred in a network element within said WDM transmission network.

30. A wavelength division multiplex transmission system according to claim 17, in which said optical transmission device comprises an auxiliary optical channel unit of fixed wavelength or of variable wavelength, in parallel with said optical channel unit, and which is used when a defect occurs in said optical channel unit.

31. A wavelength division multiplex transmission system according to claim 17, in which said optical receiving unit comprises an auxiliary optical receiving unit of fixed wavelength or of variable wavelength, in parallel with said optical receiving unit, and which is used when a defect occurs in said optical receiving unit.

32. A wavelength division multiplex transmission system according to claim 30, in which said optical transmission unit comprises an optical switch which selects wavelengths of said WDM signals from the optical channel unit and auxiliary  
5 optical channel unit.